

# *Bruce Freeman Rail Trail*

Concord,  
Massachusetts



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Prepared for: **Town of Concord  
Massachusetts**

**October 17, 2008**

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# Introduction

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## Project Description

The former Lowell Secondary Track of the Old Colony Railroad right-of-way extends in north/south direction from Lowell to Framingham. The Concord section begins just south of the Action town line, and southwest of the Route 2 Rotary. The rail bed crosses Commonwealth Avenue and passes by the MCI Concord correctional facility. The trail continues south, through West Concord to the Sudbury town line, a distance of approximately 3.5 miles (see Figure 1). The railroad alignment also crosses the MBTA Fitchburg Line railroad at-grade in West Concord center.

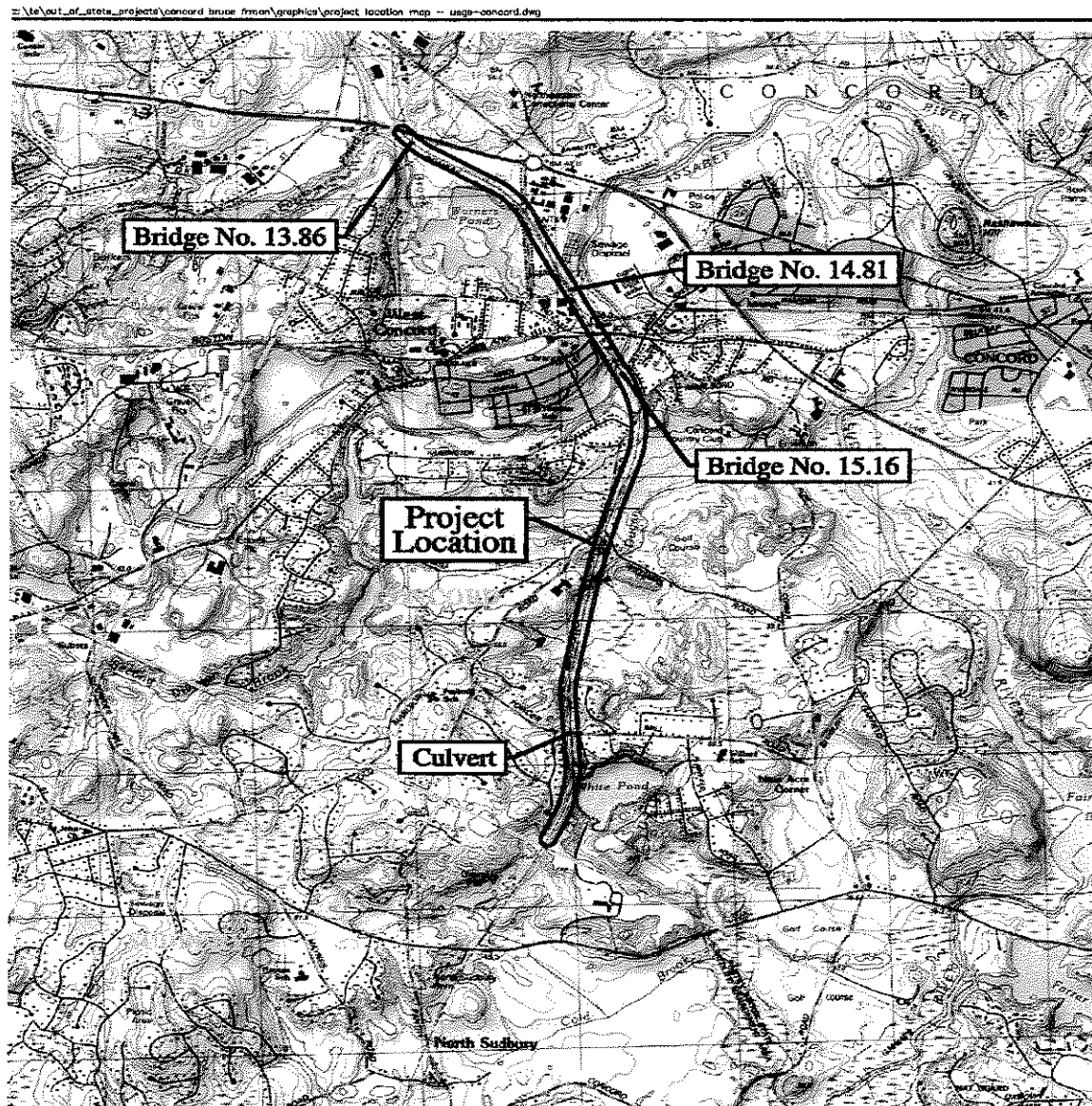
Portions of the Concord section of track were last used for rail traffic in 1993. The wood ties, steel rails and ballast are still present. The rail bed is overgrown in sections. Most of the corridor is actively used by pedestrians and off-road bikes. The Commonwealth of Massachusetts owns the right-of-way via the Executive Office of Transportation.

The Town of Concord seeks to convert this right-of-way to a rail trail to provide a multitude of recreational and transportation uses for the community. This proposed rail trail is part of the so-named "Bruce Freeman Rail Trail" (BFRT), is a proposed regional trail through the communities of Lowell, Chelmsford, Westford, Carlisle, Acton, Concord, Sudbury, and Framingham that follows the 25-mile route of the Framingham & Lowell line. Phase 1 of the BFRT (6.8 miles in Lowell, Chelmsford, and Westford) is under construction, with an anticipated opening in the summer of 2011. Phase 2 includes sections in Westford, Carlisle, Acton, Concord, and Sudbury (13.1 miles). Phase 3 includes sections in South Sudbury and Framingham (4.6 miles). The trail will be constructed mostly on the former railroad bed. In West Concord center, the trail will deviate from the rail bed around the MBTA commuter parking lot via an on-road and pedestrian route.

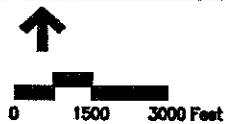
There are three existing bridge structures within the project limits: two over the Nashoba Brook and one over the Assabet River. The superstructures of the Nashoba Brook bridges remain. The superstructure of the Assabet River Bridge was removed however the cut granite block abutments remain. A former Railroad underpass at Powder Mill Road was removed and replaced with a corrugated metal pipe culvert for pedestrian use. It is proposed that the existing railroad bridges over Nashoba Brook be rehabilitated for the shared-use trail. The bridge over the Assabet River will be replaced with a new super structure. The Powder Mill Road culvert will be replaced with a cement concrete box culvert.

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**Figure 1 Project Location Map**



Source: USGS Quadrangles



**Project Location Map**  
**Proposed Bruce Freeman Rail Trail**  
**Concord, Massachusetts**

**Figure 1**



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The Town of Acton has completed a Feasibility Study and is proceeding with 25% design of their section of the BFRT.

The Massachusetts Highway Department is in the process of evaluating the reconstruction of the Route 2 Rotary. Due to the proximity of the trail corridor to the Rotary, it is anticipated that the Rotary reconstruction will include the trail crossing of Route 2. The town of Acton is also considering alternatives for the crossing of Route 2 for their section of the BFRT. Evaluation of trail alternatives for the rotary project is beyond the scope of this report.

The Town of Sudbury has also completed a Feasibility Study and is proceeding with title search, survey and environmental evaluations.

For purposes of this report, it is recommended that initial construction of the Concord section of the BFRT begin at Commonwealth Avenue opposite MCI Correctional Facility and continue south to the Sudbury line. Additional details for the phasing are included in the Construction Phasing and Cost section of this Report.

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## Project Purpose

The Town of Concord envisions a non-motorized, ADA-accessible, multi-use trail to serve as a historical, recreational and alternative transportation resource for residents and visitors of all ages and abilities. The design of the rail trail seeks to maximize the benefits of such trails for the community while minimizing its impacts on Concord residents and the natural environment. The trail will, to the greatest degree possible, retain the look and feel of a Concord woods path. It will serve walkers, joggers, bicyclists, children in strollers, cross-country skiers, people on snow shoes, wheelchair users, and others as identified during the study process.

The trail will connect West Concord Center (a vibrant commercial area that includes the MBTA commuter rail station) to neighborhoods, playing fields, and conservation lands that are located along the railroad right-of-way. It will provide non-motorized access to Concord open spaces and beautiful vistas, as well as, eventually, to those of Acton, Sudbury and other communities located along and served by the trail. The trail will provide opportunities for nature, education, quiet reflection, minimal-impact enjoyment of flora and fauna, and exercise that refresh and strengthen mind, body, and spirit.

The Town of Concord had previously completed a Feasibility Study and has retained THE CONSULTANT to prepare 25% plans and a Preliminary Design Report for the Concord section of the trail.

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## Project Development Process

The Bruce Freeman Rail Trail has a regional significance but each phase is being designed in the context of its community. The Concord section of the rail to trail project, in particular, has been developed based on local input so that the design fits the needs of the community. The design of the trail that is reflected in this report and the accompanying plans has been developed through a series of nine community outreach meetings, where the project design components have been presented to the Bruce Freeman Advisory Committee and the community, to gain input on the design of the project. Each meeting focused on a specific design topic, so that the community would receive all of the information needed to guide the design development process. The meetings were videotaped and re-run on local television access for the entire community to view. The topics covered at these meetings were:

- Design criteria/landscaping/cross sections/ surface treatment
- Bridges/amenities
- People management/trail alignment/access points
- Design concerns on trail from Acton line to Old Marlboro Road
- Design concerns on trail from Old Marlboro Road to Sudbury line
- Trail alignment through West Concord center
- Environmental issues/landscaping

Meeting notes from the meetings have been included in this report under Appendix A-1 Record of Public Comments.

# Design Criteria

The Town's vision for this rail trail is as an accessible, non-motorized, historical, recreational and alternative transportation resource for residents and visitors. The trail shall accommodate a variety of users including pedestrians, bicyclists, cross-country skiers and wheelchair users. A shared-use trail is the type of facility that can best meet the broad expectations that users have for a non-motorized trail in a setting like Concord.

A number of public comments recommended less stringent design criteria for recreational trails or greenways are used for the design of the Concord section of the BFRT. Recreational trails facilities are better suited for remote or wilderness areas to serve hikers, mountain bikers and equestrians. In many cases recreational trail design criteria does not meet the needs of all trail users that would be expected on the BFRT. Even though the BFRT is bounded in some cases by natural areas, the trail corridor is located in an overall urban area. A recreational trail in an urban setting could present trail users with sudden unexpected conflicts that would make it difficult to respond appropriately.

The advancement of the design should be developed in conjunction to and coordination with other Town initiatives such as the White Pond Advisory Committee, and the West Concord Village Overlay Study, as well as with MCI Concord, the MBTA, the Route 2 Rotary Project, and the Towns of Acton, and Sudbury.

The relevant references for shared-use trail design include: the 2006 Massachusetts Highway Department Project Development & Design Guide (MassHighway Design Guide); 521 CMR The Rules and Regulations of the Massachusetts Architectural Access Board; the American Association of State Highway and Transportation Officials (AASHTO) Guide for the Development of Bicycle Facilities, 1999 edition; American Association of State Highway and Transportation Officials: A Policy on Geometric Design of Highways and Streets (The AASHTO Green Book); and the Manual on Uniform Traffic Control Devices (MUTCD). Also referred to for trail intersection design is the Florida Department of Transportation Trail Intersection Design Handbook.

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## Design Speed

The speed that a bicyclist travels is dependent on several factors, including the type and condition of the bicycle, the purpose of the trip, the condition and location of the bicycle path, surface type, the speed and direction of the wind, and the physical condition of the bicyclist (*AASHTO Guide, page 36*). Shared-use paths should be designed for speeds at least as high as the preferred speed of the faster bicyclists but not such that the path design encourages speed. Given that the trail intersects several roadways, it is anticipated that the trail will be used by a wide range of bicyclists including experienced cyclists who utilize on-road facilities and travel at higher speeds. MassHighway and AASHTO recommend a design speed of 20 mph for general paved path surfaces on the relatively flat terrain and anticipated use by experienced cyclists. Trail design at intersecting roadways is configured to encourage a lower operating speed for bicyclists. Traffic calming measures such as signs and pavement markings on the approaching roadways are proposed to heighten motorists' awareness of a trail crossing.

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## Typical Section

The anticipated trail users include bicyclists and pedestrians such as walkers, joggers and in-line skaters. Maintenance vehicles are also expected to use the trail occasionally. Shared-use trail widths typically range from 10 to 14 feet, depending on setting and usage. The width for this trail is proposed to be the minimum 10 feet, as recommended by MassHighway.

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## Horizontal Clearances

A 2-foot wide grass strip with a 6:1 cross slope is proposed adjacent to the trail surface in the typical trail cross section. A minimum horizontal clearance of 3 feet will be maintained from the edge of the trail surface to all lateral obstructions such as poles, walls, fences, etc.

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## Vertical Clearances

A minimum permanent vertical clearance to obstructions of 8 feet is required by 521 CMR. A clearance of 10 to 12 feet for underpasses is recommended by MassHighway for maintenance and emergency vehicle access.

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## Horizontal Alignment

The horizontal alignment of a bicycle path is described as a series of tangents connected by circular curves. The minimum horizontal radius of curvature negotiable by a bicycle is a function of the super-elevation (e), coefficient of friction, type of trail surface and speed. For a general trail alignment, MassHighway recommends a curve design radius of 100 feet for a design speed of 20 mph, an  $e=2\%$  with a side friction factor of 0.28 for paved surfaces.

Since the general alignment of the BFRT is along the former railroad alignment, the current trail curve radii exceeds the recommended minimums.

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## Vertical Alignment

All designs must comply with 521 CMR; thus, the trail profile grades must be kept to a maximum of 5% for a distance of 500 feet or more. The proposed trail profile grade for this project will generally follow the existing rail bed grade. Changes in profile grades greater than 1% are accomplished by parabolic vertical curves. The lengths of vertical curves proposed satisfy the stopping sight distance requirements. (See Design Criteria Appendix – *AASHTO Guidelines Table 3.*) Since the trail corridor is a former railroad bed, grades are generally comfortable for all users.

A temporary vertical clearance of 10 feet is recommended for the initial trail construction to permit access by construction vehicles. Selective trimming of overhanging tree limbs is recommended to avoid construction damage to trees that could otherwise result in loss of the tree.

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## Trail Surface

For shared-use paths, 521 CMR requires the surface be firm, stable and slip-resistant, without slopes greater than the maximum allowed and without level changes greater than  $\frac{1}{4}$  inch.

During the study process, THE CONSULTANT staff visited numerous trails throughout New England with both paved and unpaved surfaces and discussed construction, bicycle and pedestrian compatibility, durability and maintenance requirements with the trail maintenance staff. Numerous state and federal agencies were also contacted for information on the construction, maintenance and costs issues of various trail surface materials. A summary of the information is contained in the Appendix.

The paved trail surface is proposed as a 4 inch thick Hot Mix Asphalt (2-inch modified top course over 2-inch binder course) over an 8-inch gravel base as recommended by the MassHighway Guide for shared-use paths.

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## Sight Distances

For trail crossings of public roadways, the right-of-way priority is assigned to the roadway approach and a STOP condition for trail users on the trail approaches.

For trail crossings of driveways and farm paths, the right-of-way priority is assigned to the trail. Further details of the crossing design are contained in the Traffic Issues Section.

Three types of sight distance were evaluated:

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### Trail Stopping Sight Distance

Stopping sight distance enables a vehicle traveling at or near the design speed to come to a full controlled stop before reaching a stationary object in its path. The minimum stopping sight distance for various design speeds and grades is based on a total perception and brake reaction time of 2.5 seconds, a coefficient of friction of 0.25 to account for poor weather braking characteristics, a 4.5-foot cyclist height of eye, and an object height of zero. (See Design Criteria Appendix – AASHTO Guide Figure 19.)

Thus, the SSD for bicycles traveling at 20 mph on wet pavement is 140 feet on a 5% downgrade per the AASHTO Guide Figure 19. For two-way shared-use paths, the sight distance in the descending direction will dictate the stopping sight distance.

On the roadway approaches, SSD is provided to allow motor vehicles to come to a full controlled stop before reaching the crossing. The SSD for motor vehicles with a speed of 40 mph is 305 feet minimum. (See Design Criteria Appendix – *The AASHTO Green Book Exhibit 3-1*.) Stopping sight distances at the project trail/roadway crossings meet or exceed the AASHTO Guidelines.

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### Intersection Sight Distance

Intersection sight distance allows a trail user to make the crossing maneuver before an approaching vehicle reaches the intersection. The amount of intersection sight distance depends on several factors including the time needed to cross the roadway, the distance that the approaching motor vehicle will travel in that time and the speed of the vehicle and the width of the crossing. Table 8 and Table 9 of the Florida

Department of Transportation (FDOT) Trail Intersection Handbook were referenced to verify adequate sight distance is provided at road crossings for both bicyclists and pedestrians. (See Design Criteria Appendix.) Intersection sight distances at a trail/roadway crossing meet or exceed these guidelines except for the Williams Road approach to the trail crossing at the intersection with Old Marlboro Road. Tree trimming has been proposed at this location to meet sight distance requirements. The available sight distance at this crossing is discussed in the Trail Crossings section of this report.

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## Decision Sight Distances

"Decision sight distance (DSD) is the distance required for a driver (motor vehicle or bicycle) to detect an unexpected or otherwise difficult-to-perceive information source or hazard in a roadway environment that may be visually cluttered, recognize the condition or its potential threat, select an appropriate speed and path, and initiate and complete the required safety maneuver safely and efficiently." For the motorist, the decision is whether the trail user can cross without the need for the motorist to make a safety maneuver (slow down or stop) on the roadway approaches. (Reference was made to the AASHTO, *A Policy on Geometric Design of Highways and Streets*, 2004 Green Book, Page 116, Exhibit 3-3 (See Design Criteria Appendix.)

For the trail user, decision sight distance is based on whether a bicyclist can clear the roadway from a "stop-go" decision point before approaching motor vehicles reach the crossing. From the decision point (located at the bicycle stopping sight distance from the roadway edge), a bicyclist must be able to see approaching motor vehicles prior to making the "stop-go" decision. This concept acknowledges some bicyclists' desire to maintain momentum. Providing decision sight distances on the trail approaches would require significant clearing of trees at all crossings. In some cases, removal of residential and commercial buildings may also be required. All trail approaches to roadway crossing should include redundant signs and pavement markings to encourage all trail users to stop before entering the crossings in accordance with MA traffic laws.

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## Design Waivers

The project design meets or exceeds the MassHighway, ADA and AASHTO design criteria for horizontal and vertical alignments and stopping sight distances.

To meet the criteria, complete replacement of the Powder Mill Culvert is needed. As outlined in the Construction Phasing section of this report, the Town has proposed to phase the northern limits of the trail construction to accommodate the MassHighway Route 2 rotary design and Acton's schedule for their portion of the BFRT. Town officials considered various alternatives for the trail phasing limits at the southern



end of the project and have proposed that the Phase 1 southern limits of the trail shall extend to the Sudbury line and the existing culvert at Powder Mill Road be reconstructed at this time.